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ABSTRACT

Research programs of the human learning and behavior branch of the National Institute of Child Health and Human Development (NICHHD) are described in five sections of this document. The specific programs conducted in the areas of learning and cognitive development, development of communicative abilities, biological bases of behavioral development, social and affective development, and health-related behaviors are reported in brief summaries which provide statements about research needs and problems under consideration, indicating various approaches researchers have taken in addressing the problems. A brief overview of the NICHHD's research centers and the learning and behavior branch precedes the program descriptions. In conclusion, future research emphases are recounted. Related materials are appended, including breakdowns of funding by projects in the behavioral sciences for Fiscal year 1979 (FY79), by primary disciplines (FY79), by program category (FY77-79), and by number of trainees and fellows (FY77-79). (RH)

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Research Programs of the National Institute of Child Health and Human Development

Human Learning and Behavior

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
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OVERVIEW

NATIONAL INSTITUTE OF CHILD HEALTH AND HUMAN DEVELOPMENT

The National Institute of Child Health and Human Development (NICHD) is the primary focus at the National Institutes of Health for research on maternal and child health. Through its extramural research program, it spans the full range of developmental issues, from genetics and cytology, through embryology, reproductive biology, and nutrition, to pregnancy and birth, infancy, childhood, and adolescence, into young adulthood. The Institute also is concerned with the broad range of factors that govern population growth, from basic reproductive processes and biological problems of fertility and infertility, to those social and economic forces that shape population growth and change.

BEHAVIORAL SCIENCE PROGRAMS OF THE NICHD

The term behavioral science refers to the various fields and subfields of psychology, sociology and anthropology, as well as to economics and human geography, linguistics and speech sciences, and to a host of related professional and applied disciplines. No one branch within the Institute is responsible for the entire behavioral science domain. Behavioral studies are found in every program of the Institute.

In the Center for Research for Mothers and Children (CRMC), the Human Learning and Behavior Branch (HLB) plays the key role in administering the Institute's program of research in behavioral development. Its program encompasses the development of human behavior from the perinatal period through infancy, childhood and adolescence, into early maturity. It is concerned primarily with detecting how the interaction of biological,

psychological, social and environmental factors result in normal behavioral development, and with identifying those factors which interfere with such development. The program of the Center's Mental Retardation and Development Disabilites (MRDD) Branch includes behavioral studies concerned with understanding, alleviating or preventing those disorders which result in retarded mental development, both intellectual and adaptive. Approximately 37 percent of the program of the MRDD Branch is devoted to such behavioral studies. The program of the third branch of the CRMC, the Clinical Nutrition and Early Development Branch, includes research on the relationships of nutrition to behavior.

In the Center for Population Research, the Social and Behavioral Sciences Branch supports a wide range of studies of a sociological, psychological, demographic and economic nature, relating to problems of population and family dynamics as they affect reproduction, fertility, population growth and change, and migration. Finally, within the CPR, the program of the Reproductive Sciences Branch includes research on mammalian reproductive and sexual behavior.

In fiscal year 1979, the NICHD provided a total of $35.4 million for research and research training in the behavioral sciences. The programs of the Human Learning and Behavior Branch, the Social and Behavioral Sciences Branch, and the Mental Retardation and Developmental Disabilities Branch accounted for 93 percent of the total, those of the Clinical Nutrition and Early Development and Reproductive Sciences Branches accounting for the remainder. Tables 1 and 2 in Appendix B give details of the program areas and disciplines involved in the behavioral science programs of the CRMC.

HUMAN LEARNING AND BEHAVIOR BRANCH

The Human Learning and Behavior Branch has primary responsibility within the NICHD for the study of psychological, social and psychobiological development, from infancy through childhood and adolescence into early maturity. The program has been divided into five major areas: (1) learning and cognitive development, including perception, thought and memory; (2) development of

communicative abilities, including speech, language and reading; (3) biological bases of behavioral development; (4) social and affective development and (5) health-related behaviors.

Processes and factors specific to each stage of development are studied, including the behavioral development of children born at biological risk, the psychosocial concomitants of illness and disability in childhood, and the developmental antecedents of certain disease states in adults. Also included are studies of learning problems, delayed or impaired speech and language development, and specific reading disability or dyslexia.

The fields of study involved include psychology, psychobiology, anthropology, sociology, pediatrics, behavioral medicine, linguistics and speech sciences. The great bulk of the program, however, lies within psychology. This is consistent with the interest of the Institute in the growth and development of the individual rather than in group phenomena. The "psychology" referred to ranges from physiological and experimental psychology, psychophysiology and neuropsychology, through cognitive and learning psychology, developmental psychology, and psycholinguistics, to social psychology. There is, nonetheless, an interdisciplinary character to much of the research program. Studies of infant behavior, for example, engage psychologists, neurologists, pediatricians and child psychiatrists; psycholinguistics and reading problems are addressed by linguists, psychologists, neurologists and speech specialists; and developmental psychobiology encompasses the fields of biology, psychology, the neurosciences, pediatrics and psychiatry.

The program places major emphasis on basic research but supports clinical and applied studies as well. Research in reading and language disorders, for instance, is concerned in part with the development of better clinical approaches to problems of diagnosis and remediation. Similarly, research into health-related behaviors such as smoking is essentially applied rather than basic in nature, being concerned with how children come to be initiated into risk-taking behaviors, and how effective measures of intervention can be developed, tested and applied.

Table 3 (see Appendix B) provides an analysis of the Branch's program for the last 3 years, by major program area and type of support.

RESEARCH TRAINING

The Institute has a very modest research training program in behavioral science, providing two types of support: individual postdoctoral fellowships and institutional research training grants, including stipends for pre- and postdoctoral students. In 1979, support was given for five training programs, all but one in developmental psychology, with emphasis in areas such as learning, human communication and socialization. These programs provide support for 38 predoctoral and 12 postdoctoral students. Fifteen postdoctoral research fellows also received support for research training on topics such as the dependability of newborn behavior, visual asymmetry from infancy to adulthood, sensormotor development in infancy, speech perception in early infancy, and speech perception in language-delayed children. (See Tables 3 and 4.)

PROGRAMS OF THE HUMAN LEARNING AND BEHAVIOR BRANCH

LEARNING AND COGNITIVE DEVELOPMENT

Cognitive Development in Infancy

Nearly half of the NICHD grantees who are studying perceptual, cognitive or social development during childhood are working with infants. In fact, the most intensive research focus has been on the first year, and often the first few months of life. NICHD involvement has paralleled the very rapid growth in this field.

The roots of all mental activity and social behavior can be traced to early infancy. However, until fairly recently the infant was considered a rather passive, incompetent being with little power to perceive, comprehend or influence his or her environment. Recent methodological advances have

made it possible to measure the responses of very young infants to a variety of physical and social stimuli, thus providing valuable new information about infant perception, learning and memory. The rapid changes which take place in these processes also have been traced.

Research of this sort has attracted a vigorous group of investigators supported by the Institute. NICHD grantees have used overt motor responses such as eye and head movements and sucking, as well as covert physiological responses such as heart rate, to measure visual and auditory stimuli and patterns. Investigators have determined which stimuli can be discriminated, which are given attention and preferred, and which are recognized and remembered. With these methods, they have traced the behavioral concomitants of the early maturation of the sensory and nervous systems and the growth of learning ability and cognitive capacities. These studies make it possible to more accurately assess the condition of infants who are born at risk, and to evaluate the effects on these infants of environmental regimes, programs of stimulation and parent education.

The infant's visual system and responses to visually presented stimuli have been intensively studied. The visual system is immature at birth but matures rapidly in the first few months of life.

Although the visual system has been the more thoroughly researched, the auditory system in the past few years has been the focus of considerable attention. However, only a few NICHD researchers have investigated auditory perception in early infancy. Those who have done so have studied the infant's responses to speech and nonspeech sounds, and have found that young infants are surprisingly able to discriminate a significant range of speech sounds.

Emphasis has been placed not simply on what can be seen and heard, but on how the infant perceives the world around him and on how it integrates information from different sensory modes. Developmental studies have been made of depth perception in infants, auditory-visual relationships, auditory localization and visual and tactile exploration. A current study is comparing the range of behaviors used by normal and low birth weight

infants to explore objects. Knowledge gained about an infant's development of sensory and perceptual abilities increases our understanding of its capacity to learn, understand and remember the world around it.

The study of habituation, that is, a decreased response to repeated presentations of a stimulus, allows inferences to be made about what stimuli can be discriminated, recognized and remembered. NICHD researchers have studied recognition of objects and persons, memory for briefly presented stimuli, and response to stimuli presented in various contexts. Although it had once been thought that the infant's world was a "buzzing, booming" one of unrelated sensations, it now appears that even newborns can perceive far more about their surroundings than was previously thought to be the case. The rapid changes in visual and auditory perception taking place in the earliest months of life have made early infancy a particularly fertile period for study. The results of this research have added to our theoretical knowledge about native human abilities and have been of great practical use in assessing and treating infants and young children.

Cognitive Development in Childhood

In addition to an emphasis on early infancy, attention has been given to studying those changes in perceptual, learning, cognitive and memory processes which begin in the child's second year of life and continue throughout childhood. Perception and discrimination learning are far more efficient when the child is able to focus attention on relevant features of stimuli. Researchers, therefore, have concentrated on changes with age in the child's ability to distribute attention effectively, and on those aspects of stimuli which are distinctive or salient to the child. Children appear to proceed through several age-related stages during which particular characteristics of stimuli, e.g., color, become especially salient. Later, children are able to attend to, and keep in mind, more than one dimension, for example, color and form, when discriminating between stimuli. Often children have particular difficulty discriminating and representing the orientation of two-dimensional forms, leading, for example, to early problems in writing and sometimes in reading. Therefore, researchers have emphasized perception and memory. It

has been found that children acquire the ability to discriminate orientation in an orderly fashion, first discriminating upright from nonupright, inverted from sideways and, finally, right from left.

Other investigators have been studying the development of the ability to perceive and recognize faces, voices and gait. Between age 6 and 10, the child's ability to recognize faces increases rapidly. One NICHD grantee is studying the development of facial perception, relating it to the rate and status of maturation of the right hemisphere of the brain and exploring the possible diagnostic use of relationships of this type. Another grantee has focused on the changes which occur with age in a child's strategies for remembering faces. These aspects of person recognition are especially useful in crosscultural studies of child development since they are universally important and are not usually taught in school.

Several grantees have studied the effects of age and systematic instruction on the ability of preschool and school age children to learn and remember linguistic and pictorial types of material. Deficiencies in a child's ability to label, classify and organize material result in learning difficulties which are characteristic of young children and some learning-disabled children. An important source of difficulty in memorization has been found to be the lack of an effective rehearsal strategy. Children who develop effective strategies for remembering are better able to withstand the effects of time and distraction on learned material than children without a strategy. Such children are often able to use devices intended to assist memory (mnemonics), such as the proverbial string around the finger or the use of a rhyme.

A related field, currently receiving considerable attention, is concerned with a child's awareness of how one learns and remembers, that is, metacognition and metamemory. In contrast to adults, children are less likely to monitor their own understanding and memory. The research funded by the NICHD thus typifies the trend toward the study of the child as an active organizer of information about his or her environment. The results of this research make possible new knowledge about normal developmental changes and the processes by which children begin to master their environment. This

knowledge has obvious value in understanding developmental delays, learning disabilities and mental retardation. It does appear that many children who are labeled "learning disabled" have problems organizing information that is to be remembered. Often, instruction or the provision of memory aids narrows the gap between the performances of normal and learning-disabled children.

The assumption that a child is an active organizer of his environment is also far more useful to understanding his gradual acquisition of complex concepts than the earlier view that learning achieves a connection or bond between stimuli and responses. The emphasis on how the child structures his or her own knowledge of the world has led to productive research, for example, on how the child forms mental contructs of the three-dimensional spatial world, and how he uses this information to remember both his immediate and more distant environment. New emphasis is being placed on the child's ability to comprehend material, and on the role of meaningfulness in memory. Older children make more inferences than younger children about causality in a chain of events, connecting or filling gaps in narrative material, for example. Once the content of a narrative is comprehended as a chain of causal events, the child uses this representation of the story content to retell the narrative, answer questions, draw further inferences and summarize the story. Similar studies on the development of comprehension of material presented in the visual mode, such as two-dimensional visual patterns and spatial layouts, are being undertaken by NICHD grantees.

The program of the Institute in learning, cognition and perception has emphasized development during infancy and the early preschool years. Although this emphasis warrants continued support, more research is needed on the development of these abilities during the middle years of childhood and early adolescence.

Sensory and Physical Handicaps

The study of children with major sensory and physical handicaps is another area which has great practical significance as well as potential for the development of theory. Research has lagged in this field, probably

because these children have been isolated, at home or in special schools, and also because their needs and problems have been seen in the context of special education, rather than as part of a comprehensive science of behavior. Systematic research will benefit the handicapped and will enrich and deepen our understanding of the development of the nonhandicapped. Alternative sensory/perceptual abilities have been used with increasing success to enable a blind child to "see," or a deaf child to "hear." The theoretical implications of this substitutability of sensory modalities has received little attention. Further, many children are born only partially deaf, blind or crippled. Attention paid earlier to their assets and liabilities (and to the resources of the parents, once mobilized), will yield more effective treatment or intervention and more knowledge about the impact of these conditions on the developing child. The effect of an absent sensory capacity on brain development and on the cognitive, social and affective development of children, has been given little study. This work clearly must become part of the mainstream of theoretical thinking in child development.

Preliminary meetings have been held with the new Institute for Handicapped Research in the Department of Education, where interest has been shown in the development of a collaborative endeavor with the NICHD. It is hoped that such a liaison will serve to advance research in this important and neglected area.

DEVELOPMENT OF COMMUNICATIVE ABILITIES

An estimated 10 million people in this country have a speech or language disorder which significantly interferes with communication, and about 1 out of every 4 students has a handicapping reading problem. As many as half of the students in some school systems read below expectations for their age. The Institute supports research which will enlarge our understanding of the normal development and acquisition of speech, language and reading ability, as well as those factors which interfere with the normal development of these capacities. In addition, there is interest in studying the role of speech and language in a child's social and intellectual development.

Speech and Language

Speech is important in human development and behavior. It serves as a carrier, first, of phonetic messages, then of cues to all levels of language. Although we have left behind the idea of speech "merely as sound stuff, or even spectrum stuff that has certain characteristic frequencies," investigators are still addressing certain fundamental questions regarding the nature of speech and language: Why does a series of sounds, meaningless in themselves, come to have the capacity of transmitting information from one person to another? How does this process occur? How does a language, with its complex set of rules, evolve from such an innate capacity? How does the individual infant or child learn this code? What are the rules whereby information is extracted from sound itself and transmitted to others as information? How does it develop within each single individual, and what are the physiological and psychological factors which make up this system?

The Institute continues to provide research support to answer these and related questions. Institute grantees have developed techniques for studying perception and memory for auditory stimuli, particularly speech sounds, as well as the role of auditory feedback in speech development production. Emphasis has been placed on auditory perception of speech and nonspeech sounds in infancy, including the development of the ability to discriminate auditory stimuli and patterns. Studies have been made on how young children make auditory distinctions that correspond to those made by the adult. This research shows that even very young infants discriminate between speech phonemes (sounds) in the same manner as adults. Other studies show that an infant's perception and production of speech can become restricted by the culture in which the infant is brought up. For example, Japanese infants can easily distinguish the "r" and "l" phonemes but their parents cannot.

Children with hearing handicaps are known to have difficulty acquiring normal speech and language, yet many of the underlying relationships between normal and partial hearing, and the acquistion of communicative

skills, remain unclear. To elucidate some of these unknowns, research has been carried out concerning the child's ability to respond to acoustic stimuli both for pure tone and for language-related complex sound. One investigator, for example, demonstrated that the heart rate and brain waves of newborns can be differentially changed by pure tone and complex speech-like acoustic signals. If this finding should prove to be a valid measure of an infant's ability to hear speech, it might be developed into a clinically useful technique.

The Institute has also provided support to several large research groups, in particular the Haskins Laboratories in New Haven, Connecticut. This laboratory is a national resource, not only for its pioneering research on the nature and acquisition of the speech code and the reading process, but also for the specialized assistance it gives other researchers, here and abroad. The Human Learning and Behavior Branch provides contract funds to the laboratory for the provision of sound and speech stimulus tapes, both synthetic and natural, tailored to specific research experiments, as well as specialized research training and assistance to visiting researchers.

The HLB program in communicative processes includes a modest level of support for studies of language proper, as opposed to studies of speech, concerned with the nature and production of the basic sound units of speech (phonology) and their use in specific languages (phonetics). These language studies focus on how the basic units of speech, or phonemes, are put together to form syllables and words (morphology); how words relate to each other (grammar); how words are put together to form sentences (syntax); and how words and sentences are related to convey meanings (semantics). The relationship between these different levels of language structure and function is a complex one, and much work remains to be done to find out how the child learns to use this system to think and communicate. Disorders of speech and reading are closely intertwined with difficulties in learning and using language. The Branch plans an expansion of its program on the acquisition of language.

A recent important development has been the scientific study of American Sign Language (ASL), a language long in use by the deaf but always viewed as a rather crude system of communicative gestures. Study

of the system shows that it is a true, autonomous langage with its own inner form, using a visual-manual system of communication, rather than the auditory-vocal language of hearing individuals. The ASL uses morphemes (visual signs) comparable to those used in speech (words, syllables and letters). It also has a structured method whereby these lexical units are modified, embedding the sign form within geometric patterns, such as circles, lines and arcs. Further, it imposes dynamic changes of quality on the sign, such as length, contouring, acceleration and the patterned alternative use of the two hands, comparable to the use of pitch, stress and articulation in speech.

These findings suggest that the human capacity for constructing and using a complex language system is independent of the specific sound modality in which the language originated. Until recently, all information about human language processing has come from the study of spoken language. It has now become possible, for instance, to determine the psychological processes used in the perception and memory of a language in the manual-visual mode, and to contrast these processes with those used in the vocal-auditory mode. Such studies are now being carried out by Institute-supported investigators.

A particularly intriguing aspect of these studies is that they permit the testing of current theories of cerebral dominance, or brain lateralization, since analytical, sequential processes such as language are primarily the function of the left hemisphere, whereas spatial processes, such as sequences of skilled motor movements, are commonly assigned to the right hemisphere. Whether lateralization of ASL proves to be dominated by the left or the right hemisphere, the information obtained will help to clarify the relative importance of language versus visual-spatial processing in determining hemispheric asymmetry.

Several investigators in recent years have attempted to demonstrate that the higher apes have the capacity to learn and use language. The basic question being addressed is whether language is unique to the human species or exists in other animal species as well. If the latter, what is the nature of the interrelationships between communication, cognitive processes or intelligence, and social interaction? Despite impressive evidence of the

ability of chimpanzees, under human tutelage, to use simple signs in combination to communicate meaning, it remains to be shown that they can manipulate and order such signs in the manner characteristic of human grammatical language, and that they are engaged in anything more than a complex form of operant behavior.

Whatever the outcome of these intriguing and controversial studies, the efforts are serving to demonstrate that animals have greater cognitive capacities than previously recognized and that the uniqueness of human language lies not simply in the ability to use symbols to convey meaning, but in the manner and extent to which signs are ordered and processed to permit the production of an infinite number of messages at will.

An interesting and important outcome of one project, currently receiving Institute support, is the successful application to severely retarded humans of the techniques developed to train chimpanzees to communicate with their trainers. In this program, previously nonverbal patients are using speech for the first time.

Reading and Dyslexia

Since 1964, when the first NICHD Advisory Council recommended that the Institute concern itself with the large number of children who do not learn to read, the problem of specific reading disability, or dyslexia, has been a research priority of the Institute. Dyslexia is a puzzling and complex disorder, varying from a relatively pure form of reading disability to cases in which many other symptoms occur. These may include disorders of memory, attention and comprehension, accompanied at times by hyperactivity and lack of motor coordination. Although a neurophysiological basis for dyslexia has not been proven, differences in the recordings of brain electrical activity between normal and dyslexic children have long been known to occur. No consistent pattern of responses, however, has yet been found. Also, in about one-third of all cases, there is strong evidence of a familial tendency in dyslexia, possibly genetic in origin.

One important question repeatedly asked is whether reading and listening can be regarded simply as parallel processes occurring in different modalities, converging at some point on a common linguistic path, or whether significant differences exist between the two processes. Although some children may pick up the written system on their own, the vast majority acquire it only after exposure to a formal teaching procedure. In contrast, all children, with the exception of those with severe handicaps, such as deafness or brain damage, achieve skill with oral language. Evidently these two cognitive processes, speech and reading, though closely related, are different in crucial ways. Institute-supported research shows that written language, far more than speech, places a direct demand on the individual's acquired knowledge of language -- what has been called grammatical knowledge. Such grammatical understanding is essential to efficiency in reading, as is true for learning language. Although reading and listening use the same analytic mechanism -- phonetic recoding -- analysis of a sentence is accomplished in reading, unlike listening, by means of a language acquisition procedure. Thus, reading has much in common with language acquisition. The child who has learned to use and understand language beyond what is required for simple speech is more likely to learn to read easily than the child whose language acquisition capacity has not progressed in such a manner.

As a result of the recommendations of a special workshop of experts in reading and communication, convened by the NICHD to discuss major problems in research on developmental dyslexia, the Institute obtained the services of a research team to develop, under contract, a valid and reliable test battery that can determine a child's competence in using various decoding skills essential for proficient reading. Tests have been developed which provide a detailed assessment of decoding skills. These are not only diagnostic in nature but also can be used in the prescription of remedial procedures for children with reading problems. Further, it has been demonstrated that these tests can be effectively administered to children with severe reading disability. Testing by other investigators will help to further measure their validity, reliability and usefulness with a wide range of children, both normal and those with reading problems.

"Communicating by Language" Conference Series

Since 1964, the NICHD has sponsored a series of conferences dealing with biological and behavioral research in communication. These conferences are designed to assess the current state of our knowledge in this field and to direct promising future lines of research. Eight interdisciplinary meetings of scientists have been held on topics such as the speech process, language development, reading and reading disorders and child phonology. The proceedings of the conferences have been published, a number of which have become quite well known and widely used, both for research and teaching purposes. The proceedings of these conferences are listed in Appendix A.

BIOLOGICAL BASES OF BEHAVIORAL DEVELOPMENT

Over the past 10 years the Institute has given significant support to studies of the neurological bases of behavior, behavioral endocrinology, behavioral genetics and the neurobiological correlates of behavioral disability during development. Other areas of support include psychomotor and psychosensory development, the biological bases of drive and motivation, and comparative animal studies of learning and social development.

Developmental Neurophysiology and Behavior

For many if not most functions of the brain, either the right or the left cerebral hemisphere plays a predominant role, particularly once adulthood is reached. No one function, however, is limited exclusively to one hemisphere. Clinical and experimental evidence shows that in many instances one hemisphere can take over functions normally carried out by the other if the latter should be injured or destroyed, a characteristic referred to as neural plasticity. The faculty varies both as a function of the part of the brain involved and the age of the organism. In the human, the brain continues to mature for a relatively long period of time in the postnatal phase of development. Such information is important, first, for understanding

what happens to the brain (and to resultant behaviors) as a result of insult, prenatally or perinatally and, second, what can be done to rectify any damage, temporary or permanent, which may result from factors such as anoxia, maternal use of medicines or addictive drugs, or excessive use of anesthetics during delivery. Studies are needed to determine the susceptibility of the developing brain to alterations resulting from either internal or external influences, the timing and sequential nature of such events, the specific brain structures involved, and the behavioral outcomes of such events when they do occur.

In recent years, interest has grown in the development of hemispheric specialization, also referred to as lateralization of brain function, during early childhood. It is not known whether lateralization is complete early in life, possibly even at birth, or until late childhood. There have been relatively few neurophysiological studies of lateralization of function in infants, preschoolers or young school age children, even though it is precisely at these times that right-left specialization is occurring. Results to date are somewhat ambiguous regarding the dominance of the right or left hemisphere in language function. It is quite possible that different levels of complexity in language processing are lateralized to a different degree at any one time, such as differences of timing in the development of the ability to receive language and the ability to produce language. Several important studies of hemispheric dominance for cognition, speech, language and reading ability are currently receiving Institute support.

A concurrent development is an increase in research on the neurophysiological basis of cognitive processes: thought, perception, memory, language and reading. In part, this is because of heightened awareness and concern over the apparent increase in the incidence of learning, speech and reading problems. One study is investigating the origin and meaning of a new, recently discovered brain wave in children. This brain wave occurs in response to visual and auditory stimuli which are sufficiently interesting to the child to elicit complex cognitive activity, and its occurrence, following a stimulus, is unusually delayed. Normal children from ages 1

through 10 are being studied, as well as children with learning disabilities, cognitive problems or dyslexia. This study is not only of considerable theoretical interest but might also produce an objective test of the adequacy of cognitive functions in infants and children.

Another ongoing study has recently found that neurophysiological aberrations in the brains of dyslexic children are more widespread than previously suspected. Mapping of brain electrical activity has demonstrated four distinct areas of the brain in which the electrical recordings from dyslexics differ from normals. These differences involve both hemispheres and occur both at rest and under activated testing conditions. It has not been established if these differences in brain electrical activity have sufficient specificity to permit clinical differentiation of dyslexia from other learning disabilites. The data do suggest, however, that neurophysiological testing may someday prove as useful in distinguishing various forms of learning disability as it is now in the differential diagnosis of various forms of epilepsy.

Data collection is underway in a contract-supported study designed to collect a large and systematic body of knowledge concerning neuropsychological functions in both reading-disabled and normal children. Preliminary results indicate that electrical potentials recorded from that part of the brain which controls auditory perception may discriminate dyslexic from normal children. Such results, if confirmed, will not only provide significant information on the neurophysiological processes which occur in dyslexia but also contribute to the development of a comprehensive series of tests which will provide optimal discrimination between normal and reading-disabled children -- the primary goal of the study.

The Branch has plans to expand its program in developmental neurophysiology and behavior.

Neuroendocrine Function and Behavior

Since the late 1950's, it has been known that sex hormones have a direct influence on the developing brain, resulting in characteristic male or female behavior. It seems, in fact, that mammalian behavior patterns are

basically female and that male patterns are induced by the action of the sex hormone testosterone on the brain of the animal, either before or after birth. If male animals are experimentally deprived of testosterone in the first few days after birth, they exhibit clear signs of female sexual behavior. On the other hand, when a female is deprived of her female hormones, estrogen and progesterone, she loses her normal female behavior but does not develop male behavior unless injected with testosterone. To extend these findings, the Institute is supporting studies seeking to learn if other behavioral differences exist between male and female based on the type and level of sex hormones in the blood. Some initial studies in this area, carried out by other NICHD-supported investigators, suggest that there may well be such differences -- in temperament, motivation, cognitive style and affectional expression.

It is also important to ask whether other hormones of the endocrine system, for example, the thyroid or adrenocortical hormones, also have an influence on the developing brain. If so, what is the nature of that influence, at what stages of development does it occur, and what specific brain structures are affected?

In addition to research on the relationship between hormones and gender-specific behaviors, much research has been directed at the role of the pituitary-adrenal system in modulating behavioral responses. Institute-supported animal research has contributed to the now well-established finding that this system is part of an arousal system, sensitive to stress. One such study is concerned with the role of the neuroendocrine system in social bonding, or attachment, of the mother to the infant, and the infant to the mother. Until recently, most studies have been concerned with the effect of stress, such as separation, on the infant, with little or no attention to the neuroendocrine responses occurring in the mother. This study is examining the effects of separation on both mother and infant, the specificity of response, and the role of environmental factors. It is known that such stressful experiences during early development, if sufficiently severe and prolonged, can have permanent consequences. How severe, for what periods of time, and at what stages of development such stresses must occur

to result in severe maladaptive behaviors in later life, and what the neuroendocrine and other physiological concomitants and sequelae of such events may be, are questions now under study by several Institute-supported investigators. Answers are also being sought to the questions of whether, how and to what extent such maladaptive behaviors can be changed, and what role behavioral and social variables play in such a process.

Much experimental work has been done in animals on the role of the endocrines in behavioral development. Likewise, clinical studies have been carried out in humans during infancy, childhood and adolescence, on conditions such as hypothyroidism, abnormalities of sexual development, and disorders of pubertal onset. The Institute has supported a number of these studies. Much more needs to be done, however, to relate normal somatic and physiological growth, as modulated by the endocrine system, to normal behavioral development in humans.

The Branch plans to stimulate such research, particularly during infancy and early childhood. It also plans to place more emphasis on the relation between endocrinological changes occurring during puberty and the behavioral development of the early adolescent. It is quite possible that some of the difficulties of mood, temperament and interpersonal stress experienced by adolescents reflect the impact of gonadal hormones. A behavioral endocrinology of puberty and adolescence is in its early stages of development, and needs to be encouraged.

Developmental Behavioral Genetics

The Institute's program of research in behavioral genetics is a modest one. It consists of two types of research, experimental animal studies and human studies, which differ in a number of ways, methodological, conceptual and phenomenological. In one animal study, the investigator is systematically varying the early experience of a large population of animals by exposing each new-born animal to red, blue or white light for different lengths of time during early development. It is then being determined whether, when, and to what extent preference for a specific color will be exhibited in subsequent generations, and how stable such behavior is.

The investigator's goal is to establish a model system for studying the interaction of genetic, maturational and experiential variables in producing a specific form of behavior.

An Institute-sponsored study in humans is assessing the relative influence of genetic and environmental factors in visual perception in four hundred European and Japanese families. Some 25 separate measures of visual perception, such as visual acuity, brightness and eye dominance, are being used. Linkage with various blood group and protein markers are being examined, as well as associations with age, sex, socioeconomic status and cognitive performance. Since it is known that racial differences of a genetic nature exist in sensory-processing characteristics, it is possible that single-gene effects will be found.

Another genetic study underway has undertaken to identify several etiologically distinct subtypes of reading disability. Although, as previously stated, there is evidence of a familial tendency in reading disability, the population as a whole appears to be genetically heterogeneous. An attempt is being made, therefore, to determine whether a specific subgroup of dyslexia exists which exhibits true genetic dominance. The research, which will use genetic linkage and localization techniques, is being limited to a study of chromosome 15, previously identified as linked to the occurrence of dyslexia. The study may succeed in determining whether or not reading disability is a unitary, homogenous attribute and whether the familial component known to exist among dyslexics is truly genetic in nature, at least for a specific subset of dyslexics. If genetically distinct subtypes of dyslexia are found, a major step toward clarification of this confusing field will be taken. Such a finding would be comparable to that of trisomy, a specific genetic defect occurring in Down syndrome, one of many types of mental retardation.

Prenatal and Perinatal Influences on Infant Behavior

Many prenatal and perinatal factors may result in slight to severe behavioral deficits in newborn infants. These factors include prenatal maternal use of drugs, anoxia and infection; perinatal complications during

the birth process; and postnatal factors such as disease, accidents and neglect. Premature babies, especially those small for gestational age, are generally considered at risk also. These conditions may or may not result in significant behavioral deficits. Much behavioral research on infants born at "developmental risk" has consisted of follow-up studies to determine the effects of such deficits on behavioral development, both short- and long-term. Developmental examinations, including neurologic, behavioral, speech, cognitive and social interactional measures, have commonly been used. Other studies have focused on differences between at-risk and nonrisk infants, comparing a wide range of behaviors, such as psychophysiologic responses, states of sleep and arousal, attention, memory and object exploration. Some research also has been carried out to evaluate the effectiveness of specific interventions, such as introducing parents to intensive care nurseries, ending the practice of separating premature newborns from their parents, and providing sensory stimulation to these children.

The Institute has contributed support to a number of studies in these areas over the years. The Branch currently supports studies on the relation between prematurity, early social interaction, and the development of social competence; the social and psychological consequences for the child and for the parents of cesarean childbirth; the effects of maternal smoking during pregnancy on neonatal behavior and subsequent behavioral development, and the impact of the use of analgesia and anesthesia during labor and delivery on postnatal behavior.

Most of the studies to date have been essentially descriptive, and the overall results obtained from them can be summarized as follows: adverse prenatal and perinatal conditions result in considerable heterogeneity of outcome; developmental status during infancy, as currently measured, does not correlate highly with behavioral status in later childhood; and supportive rearing conditions are, in many instances, associated with improved behavioral and intellectual status in later childhood. If advances are to be made in this area, the basic mechanisms underlying these findings must be explored, and the research must be guided by specific developmental theories.

Some of the questions to be answered in such studies are: What specific constraints or limitations exist for each prenatal or perinatal condition in terms of potential for growth and development? What are the range and diversity of behaviors that are available to such infants and children, as well as the organization and adaptability of such behaviors? What limitations or deficiencies may be overcome by appropriate environmental input? Which psychological/behavioral factors are most affected by adverse conditions, and which are most amenable to change? What similarities or differences can be found between the mildly and severely impaired infant? Why do some apparently severely impaired infants do so well in later life, and others, apparently minimally impaired, do so poorly?

The Branch plans to broaden the scope of its support in this area in the future. The increasing success of medical practice in helping infants born at risk to survive makes it imperative that we obtain more definitive information on the behavioral outcomes of deleterious prenatal perinatal and postnatal factors, both short- and long-term. Such information is needed in order to develop more timely and effective preventive and corrective measures.

SOCIAL AND AFFECTIVE DEVELOPMENT

Infancy and Childhood

The Branch's program in the social and affective development of young children is small compared with its other programs. About half of the scientists supported in this area of research study children 2 years of age or younger, through the late preschool or early grade school years. In several cases the same group of children has been followed in short-term longitudinal, or follow-up, studies. There is a marked interest in factors which contribute to social development, such as the physiological and cognitive processes taking place within the child and the child's social

environment, including parents and peers. One large project tracing the development of several groups of children is studying the association between levels of sex hormones found in blood taken from the umbilical cord at birth, and the temperament and gender-related behavior, such as rough and tumble play, of preschool boys and girls. The recent increase in knowledge about cognition has led to important investigations of social cognition. These studies trace the growth of a child's ability to understand the emotions, motivations and goals of others, to infer the causes and outcomes of social acts, and to attribute personality characteristics to others.

Researchers in the field have moved from a preoccupation with a child's aggression to an emphasis on prosocial behavior, such as generosity, sharing, helping and caretaking. A researcher engaged in longitudinal and cross-sectional studies of this type of behavior in 1- to 3-year-olds is constructing a scale of social development. She notes that no current theory predicts a "prosocial infant." Nevertheless, these behaviors are common in the very young. Another grantee is studying the beliefs children have about the desirability of generosity, and techniques of parents for motivating children to help and share.

Still another focus of recent research is the study of relationships between peers and the growth of social effectiveness in the context of a child's friendships. Interactions between children of the same age and different ages have been intensively studied and may yield valuable data that will aid in treating "isolate" behavior in children. Studies by several grantees include the diverse ways in which cognitive variables contribute to social development. For example, studies of peer behavior include a focus on problem-solving within children's groups and on children's use of rules.

Although the Branch supports a number of important studies in social and affective development, this aspect of its program needs expanding. In particular, a need exists for research directed to a child's behavior in natural settings, especially within the context of the various family forms common today. The complex sources of the development of sex differences and gender roles are in need of study. Research on development

in the middle years of childhood and studies of children's social development should be moved beyond their present largely cognitive focus to include an emphasis on motivation and emotional development, as well as on the specific social contexts and role relationships inside and outside the family which serve to help a child define his or her sense of being and relatedness to others.

Adolescence

Adolescence is a period during which profound changes, biological, cognitive and social, take place in the individual. The child undergoes a major growth spurt, expands its abilities in abstract reasoning, and acquires an enhanced sense of self-awareness and self-regard, and an awareness of his or her social role and place in society, all in preparation for assuming an adult role.

As is true of the program on social and affective development during early childhood, the Branch's program in adolescence is quite modest compared to its other programs. Most of the research on adolescence supported by the Branch has been either on smoking behavior or on speech and reading problems. However, a wide range of studies is currently receiving support, such as research on the development of complex problem-solving abilities, reasoning and scientific thinking; moral development; the differential effect of adolescent experience on males and females; the significance of menstruation for adolescent females, and psychohormonal studies of abnormalities in sexual function during development. The Institute has also supported a long-term follow-up study of school achievement, IQ and other cognitive abilities among adolescents who as preschoolers had been enrolled in Head Start programs. Evidence was obtained that the Head Start experience resulted in a significant gain in school achievement and measured IQ in these children as compared to those with no Head Start experience.

The paucity of integrated studies in normal adolescence within the program of the Institute reflects the status of the research field at large. A recent Institute-sponsored review of current research in developmental

psychology concluded that "adolescence remains the most seriously understudied period in social and emotional development." Studies have generally been descriptive, have relied on self-reports, and have been conducted almost exclusively in classroom situations.

A first requirement for further research on this topic is to appreciate that the adolescent period, from early puberty to late adolescence, covers 11 years, from 10 to 21. Thus, adolescence spans a number of maturational stages marked by changing social, affective and cognitive abilities and needs. Generalizations about behavior during this period make no more sense than do generalizations covering the age span from infancy to age 11.

The issues of early adolescence relate to the transition from preadolescence to adolescence. We need to better understand the impact of changes in social relationships within the family and within the peer culture that occur with the onset of puberty, including changing self-concept and sex-role identity. This period of rapid physical and psychosocial development is generally stressful. The nature of stress during adolescence, the critical events leading to it, and the development of competency in handling are not well understood. This age period is also characterized by a "present" orientation, frequently associated with rebelliousness and risk-taking behaviors, but little is known of the antecedent conditions that lead to such behavior.

The older adolescent has more ties to his peer group, is more "future" oriented, and is confronted with options (or the lack of them) for his or her life after high school, specifically in terms of achieving a self-constancy, assuming adult roles, and choosing a career or job. For many high school students, part-time work is a major after-school activity. Research is needed on the role of school and workplace achievement in the enhancement of self-regard and the development of competence.

The Branch plans to develop its program of research on the psychosocial aspects of adolescent development, together with an emphasis on the behavioral endocrinology of puberty and early adolescence.

The Family

The family provides a supporting structure for the development of the child from infancy, through childhood and adolescence, into maturity, and exerts a powerful influence on all aspects of behavior -- cognition, language, social and affective development and health behavior. Amid frequent predictions that the traditional nuclear family may not survive, a 1979 Census Bureau study reports that, "Despite the demonstrable delay of marriage, the decline in family size, the upturn in divorce, and the increasing diversity of living arrangements, the overwhelming majority of American people still live in nuclear family households. The delay in marriage should eventually have the more favorable side effect of expanding the range of social relations of maturing adults before they marry, thereby increasing the chances that they will make a more rational choice of a marriage partner or a rational choice never to marry. As more young adults delay marriage, they increase the chances, also, that they will delay childbearing and bring fewer unwanted children into the world" (Glick). To support this conclusion, 1978 Census figures indicate that 78 percent of all children under 18 years of age lived with two parents (natural or stepparents), 19 percent with one parent. The latter figure doubles the percentage of one-parent families existing in 1960 (9 percent). More than three times as many black children as white were reported living with a single parent. Three percent of the children under 18 years lived with neither parent (usually with relatives) in 1978.

In contrast to earlier research which typically focused on the one-way effect of parents on children, currently supported NICHD grantees are studying the simultaneous and reciprocal interactions which occur between family members. Such research has been made possible, in part, by the development of improved observational, recording and analytical procedures. In one such study, observations are being made of the home behavior of families with chronically ill children as compared to those with normal children, in order to understand how families handle episodes of recurring illness in children.

In recent years behavioral scientists have been encouraged to gather observational data on family relations in "real life" situations and to use the data to build more adequate theories of family dynamics. This kind of family-focused research can enhance our understanding of how an individual's predispositions (temperament, sensitivity to sensory input, self-esteem, ability to cope) develop in relation to interpersonal characteristics such as dependence, identification with others, need for affiliation, autonomy and competition. These basic dispositions and interpersonal styles need to be related to the actual experiences encountered by the child in the family during different stages of development; and these, in turn, need to be related to the development of social competence, capacity for growth, capacity for broad interpersonal relationships, and the ability to cope under stress.

Specific topics to be investigated include the effect of various parental styles of rearing (authoritarian, democratic, laissez-faire) on children's social competence and capacity for growth; how family living styles affect sex role development; the impact on the child of being an only child, the oldest, youngest or sometimes neglected "middle child," and the effect of sibling relationships. Studies of sibling relationships might well include a focus on the social supports provided by older children to their younger siblings, as well as the effect of sibling rivalry and parental handling of it. Other important topics include the long-term implications of divorce, remarriage and stepparenting on the child and on the parents; the ability of certain children to thrive despite adverse upbringing; and the bearing of intrafamily relations on relationships with schoolmates and peers, as well as subsequent relations with marriage partners and individuals in the workplace.

HEALTH-RELATED BEHAVIORS

The Institute has had a continuing interest in the role which behavioral factors play in physical disease and illness, both acute and chronic. Research in this area includes studies of the psychosocial adaptation of the child and its family to being ill, hospitalized or in pain, psychological stress included.

As a result of a 1979 research initiative on "health promotion and the prevention of smoking and other behaviors detrimental to health," the Institute has significantly increased its support of research on the development of health-related behaviors in children and their families, as well as research on the prevention of behaviors harmful to health, such as overeating, accident-related behavior and smoking. For example, in an attempt to understand how healthy behavior develops in children and their families, two investigators are studying how health attitudes and practices develop in nursery school children in relation to personal cleanliness, nutrition, dental care and safety. The most heavily supported aspect of research on children's health behavior concerns cigarette smoking in children and adolescents. In spite of the decrease in adult smoking over the past 10 years, an alarming increase in cigarette smoking has occurred among teenagers, particularly adolescent girls. Previous research findings implicate three influences leading children to smoke: parents, peers and the mass media. A number of studies suggest that the smoking parent serves as a model for the child. A child is apparently more apt to smoke if both parents smoke than if only one does -- or if neither parent does. If an older sibling and both parents smoke, a child is about four times more likely to smoke than if no one in the family smokes. Similarly, if a child's best friend smokes, he is more apt to take up smoking. As a result of the Institute's initiative on smoking behavior, a number of studies are receiving support to investigate, in greater detail, the psychosocial, familial and peer group factors responsible for the onset of smoking.

Some evidence exists that adolescents who smoke cigarettes are more likely to engage in other risk-taking behaviors (the use of alcohol, marijuana and physical risk-taking) than those who do not smoke. One NICHD-funded project is studying the factors that prompt adolescents to take up cigarette smoking and other behaviors detrimental to health, and is developing an intervention program to promote alternatives to unhealthy behavior. Another investigator has undertaken to identify the critical intra-individual and interpersonal factors responsible for an adolescent moving from occasional (experimental) smoking to habitual smoking.

In addition, two grantees are studying the impact of maternal smoking in pregnancy on a child's behavioral and cognitive development.

In October 1979 the Institute sponsored a workshop on "Smoking Behavior in Children and Adolescents" to help NICHD-supported investigators clarify theoretical issues and develop common methodological strategies. In their discussion of methodological issues, the participants recognized the limitations of earlier studies. Many findings have not been generalizable because studies (mostly surveys) focused on children at only one point in time, consensus was lacking on definitions of levels of smoking (the nonsmoker, the beginning, experimental, occasional, regular and ex-smoker), information was derived solely from self-reports (generally seen as unreliable among children and adolescents), and control groups were often lacking. The participants agreed to share strategies in terms of defining levels of smoking, developing a core of questionnaire items, using biological tests as validators of self-reports, and measuring subjects and controls over time. A second workshop of NICHD-funded investigators will focus on problems encountered in data collection, management and analysis.

The Institute's research initiative on smoking and other risk-taking behaviors will be continued as a priority area, and will include the development of new intervention strategies to discourage smoking by pregnant women. Other areas to be developed include the psychosocial adaptation of the child to being ill, and the role of the family in developing positive attitudes toward health-promoting activities.

FUTURE RESEARCH EMPHASES

The plans of the Institute to develop and expand the program of the Human Learning and Behavior Branch have been discussed throughout the report. Major future emphases are:

LEARNING AND COGNITIVE DEVELOPMENT

The Institute has had a strong program of research perception, learning, cognition and memory in infancy, which will be continued. In the future, emphasis will be placed also on research on the further development of these processes in the middle years of childhood and adolescence. Encouragement also will be given to the use of learning and cognitive measures for the behavioral assessment of infants born at risk, as well as to research on learning disabilities across the full span of childhood and adolescence.

DEVELOPMENT OF COMMUNICATIVE ABILITIES

Researchers on dyslexia will continue to be a priority area. Also, greater emphasis will be placed on research into the more complex aspects of speech and language development, such as the acquisition of grammatical ability; the interrelationship during development between language and cognitive abilities; and the relation of the communicative aspects of speech to the development of social competence.

BIOLOGICAL BASES OF BEHAVIORAL DEVELOPMENT

The neurophysiological bases of behavioral development, including the role of neural plasticity, lateralization of brain function, and development of cognitive abilities, will continue to be studied. Also, the impact on behavioral development of somatic and physiological growth, of endocrinological changes during puberty, and of deleterious prenatal and perinatal factors, will be explored.

SOCIAL AND AFFECTIVE DEVELOPMENT

Social and affective development research will be expanded to include the middle years of childhood, in addition to infancy and early childhood. Also to be studied are: The role of the family, including the impact on the child

of new forms of family living arrangements, gender-role development and the sources of sex differences in behavior, adolescent development, including the effect of pubertal changes on social development in early adolescence, as well as the development of competence and achievement in later adolescence; and development of peer and sibling relationships.

HEALTH-RELATED BEHAVIORS

The Institute's research initiative on smoking behavior in childhood and adolescence will continue to be a priority area. Other areas to be developed include the psychosocial adaptation of the child to illness and stress, and the role of the family in the development of positive attitudes toward health-promoting activities.

APPENDIX A

PROCEEDINGS OF THE "COMMUNICATING BY LANGUAGE" CONFERENCE SERIES

House, Arthur S. (Ed.): Communicating by Language: The Speech Process (Proceedings of the conference "The Speech Process," April 26-29, 1964, Princeton, N.J.). U.S. Department of Health, Education, and Welfare, Public Health Service, National Institute of Child Health and Human Development (unnumbered publication). U.S. Government Printing Office, Washington, D.C., 1965, 323 pp.

Smith, Frank and Miller, George A. (Eds): The Genesis of Language, A Psycholinguistic Approach (Proceedings of the conference "Language Development in Children," April 25-28, 1965, Old Point Comfort, Va.). The MIT Press, Cambridge, Mass., 1967, 400 pp.

Kavanagh, James F. (Sc. Ed.): Communicating by Language: The Reading Process (Proceedings of the conference "Communicating by Language, The Reading Process," February 11-13, 1968, New Orleans, La.). U.S. Department of Health, Education, and Welfare, Public Health Service, National Institute of Child Health and Human Development (unnumbered publication). U.S. Government Printing Office, Washington, D.C., 1968, 228 pp.

Kavanagh, James F. and Mattingly, Ignatius G. (Eds.): Language by Ear and by Eye, The Relationships between Speech and Reading (Proceedings of the conference "Relationships Between Speech and Learning to Read," May 17-19, 1971, Belmont, Elkridge, Md.). The MIT Press, Cambridge, Mass., 1972, 398 pp.

Kavanagh, James F. and Cutting, James E. (Eds.): The Role of Speech in Language (Proceedings of the conference "Communicating by Language, The Role of Speech in Language," October 7-10, 1973, Urban Life Center, Columbia, Md.). The MIT Press, Cambridge, Mass., 1975, 335 pp.

Kavanagh, James F. and Strange, Winifred (Eds.): Speech and Language in the Laboratory, School, and Clinic (Proceedings of the conference "Communicating by Language, The Implications of Basic Spech and Language Research for the School and Clinic," May 23-26, 1976, Belmont, Eldridge, Md.). The MIT Press, Cambridge, Mass., 1978, 511 pp.

Kavanagh, James F. and Venezky, Richard L. (Eds.): Orthography, Reading and Dyslexia (Proceedings of the conference "Communicating by Language, Orthography, Reading, and Dyslexia," September 18-20, 1978, National Institutes of Health, Bethesda, Md.). University Park Press, Baltimore, Md., 1980, 325 pp.

Yeni-Komshian, Grace H., Kavanagh, James F. and Ferguson, Charles A. (Eds.): Child Phonology: Perception and Production (Proceedings of conference "Child Phonology," May 28-31, 1978, National Institutes of Health, Bethesda, Md.). Academic Press, New York, N.Y. In press.

APPENDIX B

Table 1

CRMC PROJECTS IN THE BEHAVIORAL SCIENCES, FY 1979

Funds (thousands)

Category	Total CRMC		HLB		MRDD		CNED	
	No.	Funds	No.	Funds	No.	Funds	No.	Funds
Total	387	$23,905	166	$11,962	199	$10,222	22	$1,721
Human	341	21,892	141	10,740	183	9,576	17	1,576
Animal	46	2,013	25	1,222	16	646	5	145
Learning & Cog. Development	112	6,423	51	3,038	56	2,809	5	575
Human	105	5,983	47	2,831	53	2,577	5	575
Animal	7	440	4	208	3	232	-	-
Developmental Beh. Biology	110	6,353	48	3,203	49	2,175	13	976
Human	75	5,073	29	2,420	38	1,822	8	831
Animal	35	1,280	19	783	11	352	5	145
Language & Communication	66	4,473	37	2,981	29	1,493	-	-
Human	65	4,355	36	2,862	29	1,493	-	-
Animal	1	118	1	118	-	-	-	-
Social & Affective Develop.	52	2,805	13	749	36	1,920	3	136
Human	50	2,669	12	636	35	1,896	3	136
Animal	2	137	1	113	1	24	-	-
Education	25	1,545	1	54	24	1,491	-	-
Human	25	1,545	1	54	24	1,491	-	-
Animal	-	-	-	-	-	-	-	-
Smoking & Other Health-related Behaviors	14	1,778	13	1,745	-	-	1	34
Human	14	1,778	13	1,745	-	-	1	34
Animal	-	-	-	-	-	-	-	-
Psychology, General	5	366	3	192	2	174	-	-
Human	5	366	3	192	2	174	-	-
Animal	-	-	-	-	-	-	-	-
Other Psychology	2	56	-	-	2	56	-	-
Human	1	18	-	-	1	18	-	-
Animal	1	38	-	-	1	38	-	-
Demography	1	105	-	-	1	105	-	-
Human	1	105	-	-	1	105	-	-

Notes: (1) Subprojects of program projects are counted individually.
(2) Includes research, training and contracts.
(3) Excludes one subproject ($51,570) of a program project which is biomedical.

Key: CRMC = Center for Research for Mothers and Children
HLB = Human Learning and Behavior Branch
MRDD = Mental Retardation and Developmental Disabilities Branch
CNED = Clinical Nutrition and Early Development Branch

Table 2

CRMC BEHAVIORAL PROJECTS, BY PRIMARY DISCIPLINE, FY 1979

Funds (thousands)

Discipline	Total CRMC		HLB		MRDD		CNED	
	No.	Funds	No.	Funds	No.	Funds	No.	Funds
Total	387	$23,905	166	$11,962	199	$10,222	22	$1,721
Psychology	279	16,738	117	7,785	143	7,311	20	1,673
Demography	1	105	-	-	1	105	-	-
Sociology	11	546	2	142	8	400	1	3
Education	9	645	2	241	7	404	-	-
Mathematics & Statistics	1	40	-	-	1	40	-	-
Speech/Learning/Language	81	5,499	45	3,793	35	1,675	-	-
Computer Sciences	1	20	-	-	1	20	-	-
Social & Cultural Anthropology	1	45	-	-	-	-	1	45
Epidemiology (Behavioral)	1	11	-	-	1	11	-	-
Social Work	1	122	-	-	1	122	-	-
Multidisciplinary	1	133	-	-	1	133	-	-

Notes: (1) Subprojects of program projects are counted individually
(2) Includes research, training and contracts.
(3) Excludes one subproject ($51,570) of a program project which is biomedical.

Key: CRMC = Center for Research for Mothers and Children
HLB = Human Learning and Behavior Branch
MRDD = Mental Retardation and Developmental Disabilities Branch
CNED = Clinical Nutrition and Early Development Branch

Table 3

NICHD GRANTS AND CONTRACTS IN THE HUMAN LEARNING AND BEHAVIOR BRANCH BY PROGRAM CATEGORY, FY 1977 - FY 1979

Funds (thousands)

Program Category	FY 1977					FY 1978					FY 1979				
	Total	Research	Training	Fellow-ships	Contracts	Total	Research	Training	Fellow-ships	Contracts	Total	Research	Training	Fellow-ships	Contracts
Total	7,380	6,259	689	115	316	7,242	6,077	552	202	411	12,013	10,092	591	203	1,128
Developmental Behavioral Biology	1,702	1,659	-	43	-	1,706	1,625	-	81	-	1,974	1,848	62	54	10
Human Learning, Cognition, Perception, Memory	3,123	2,610	484	28	-	2,902	2,411	439	52	-	3,435	2,854	529	52	-
Social and Affective Development	816	787	-	29	-	786	771	-	15	-	864	836	-	29	-
Human Communicative Processes	1,739	1,202	206	15	316	1,848	1,269	113	55	411	3,739	2,927	-	68	744
Health-related Behaviors (new in FY 1979)											2,001	1,627	-	-	374

Number of Projects

Program Category	FY 1977					FY 1978					FY 1979				
	Total	Research	Training	Fellow-ships	Contracts	Total	Research	Training	Fellow-ships	Contracts	Total	Research	Training	Fellow-ships	Contracts
Total	130	111	8	8	3	123	99	6	16	2	167	141	5	15	6
Developmental Behavioral Biology	34	31	-	3	-	34	28	-	6	-	36	30	1	4	1
Human Learning, Cognition, Perception, Memory	55	48	5	2	-	53	45	4	4	-	57	49	4	4	-
Social and Affective Development	16	14	-	2	-	11	10	-	1	-	14	12	-	2	-
Human Communicative Processes	25	18	3	1	3	25	16	2	5	2	44	35	-	5	4
Health-related Behaviors (new in FY 1979)											16	15	-	-	1

Notes (1) Subprojects of program projects are counted individually.
(2) Contract figures include Minority Biomedical Support grants.

Table 4

NUMBER OF PREDOCTORAL/POSTDOCTORAL TRAINEES AND FELLOWS IN THE HUMAN LEARNING AND BEHAVIOR BRANCH
FY 1977 - FY 1979

Number

Category	FY 1977			FY 1978			FY 1979		
	Full-time Equivalent Trainees		Fellows	Full-time Equivalent Trainees		Fellows	Full-time Equivalent Trainees		Fellows
	Pre	Post	Post	Pre	Post	Post	Pre	Post	Post
Total	57	1	8	57	5	16	38	12	15
Developmental Behavioral Biology	-	-	3	-	-	6	-	3	4
Human Learning, Cognition, Perception, Memory	35	1	2	43	5	4	38	9	4
Social and Affective Development	-	-	2	-	-	1	-	-	2
Human Communicative Processes	22	-	1	14	-	5	-	-	5

Note: A total of 12 separate training grants supported the predoctoral/postdoctoral trainees during FY 1977 - FY 1979.

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